Plan for an

Enabling Technology Center in Crises Management[1]

For Public Comment

"Preparing for and responding to crises place demands on information technology that cannot be satisfied readily with existing tools, products, and services. These unmet demands point to many promising research directions…" (Computing and Communication in the Extreme, National Academy Press, 1996.)

This draft proposal, prepared by the Information Technology for Crises Management (ITCM) Team[2], responds to the President's Information Technology Advisory Committee's (PITAC) recommendation to establish Enabling Technology Centers (ETCs). An ITCM ETC may be proposed as part of an FY 2001 expansion of the President's Information Technology for the 21st Century (IT^2) initiative proposed to begin in FY 2000.

Background

Effective crisis management can help save lives, reduce economic loss, and preserve property, making it a high priority on the national agenda. It requires the ability to assess changing situations, deploy life-saving resources, and monitor results in the face of large amounts of information from sophisticated and *ad hoc* sources of uncertain reliability. Information technology already plays a critical role in effective crisis management, but further advances in information technology will enable us to better prepare for, respond to, and mitigate against various hazards that threaten our society.

An ITCM ETC will focus primarily on applied research and development for disaster management. ITCM ETC researchers will conduct R&D to support crises management, develop educational curricula for students and career professionals in the emergency management field, and help transfer new technology to appropriate organizations. The ETC R&D efforts will be determined by the needs of the disaster management community.

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[1] *The preliminary report from the December 1-2, 1998 National Academies Workshop: Research on Information Technology to Support Crisis Management is expected any day. This draft proposal may be revised based on this report.*

[2] *The Information Technology for Crises Management Team is a coordinating team of the Federal Information Services and Applications Council (FISAC). The FISAC reports to the Subcommittee on Computing, Information, and Communications (CIC) R&D of the Committee on Technology, which reports to the Presidential National Science and Technology Council.*

Proposed Research and Development

An ITCM ETC will develop the ability to use vast quantities of information from all sources including the pervasive sensing environment of the future, assess the quality of that information, integrate it into a unified picture of the evolving situation, model alternative response scenarios, present situation views to the responders tailored to their needs and responsibilities, communicate that information throughout the response effort to help the decision makers develop the best course of action, and monitor the outcome of actions. In order to accomplish these goals, the ITCM ETC will carry out R&D in:

1. Networking technologies, communication tools, deployment technologies, and management, including:

   - The ability to rapidly deploy wireless networking to an emergency scene where the existing infrastructure has been damaged or destroyed

   - Nomadic technologies to provide the right people with the right access and information at the right time

   - Adaptive networking to reconfigure the network both after disaster-related losses occur and as the response team adds new capabilities

   Crisis management requires different means of communication for the various crisis response participants and locations. For example, wireless telecommunications are needed for the relief worker and the damage assessor. Relief effort managers need access to wireless, satellite, and wireline high speed telecommunications and computing, using high end workstations and displays, as well as remote access to high end computing facilities. Perhaps the most advanced technologies, including data visualization corridors (DVCs) and tele-immersion, are needed at the disaster centers.

2. Distributed high end computing for simulating natural disasters

   Models for global climate and weather events such as hurricanes exist and are continually being improved; indeed hurricanes are the only natural disasters for which simulations can be done both before and during the event so that response plans can be made and updated as the hurricane progresses. These simulations rely on collecting meteorological data and incorporating those data in the simulations. R&D is needed in developing similar models and data collection and assimilation technologies for other natural disasters such as earthquakes, fires, floods (both river and flash), tornadoes, tsunamis, and volcanoes. In a crisis situation, it may be necessary to employ a meta-computing (or computational grid) strategy to access adequate computing resources. Recent evidence indicates that the U.S. has fallen behind Europe in weather and storm simulations because of inadequate computing power. An ITCM ETC might provide the most advanced computing resources available anywhere, and such a system might be part of a worldwide computational grid available during international disasters.

3. Meta-computing for mitigation guidance for sustainable communities

   The development of accurate disaster/damage models for response purposes can be applied using simulations to evaluate risk at the local area. These risk evaluations can in turn be used to guide the use of building codes and other mitigation strategies

to limit or even prevent damage before it occurs. Post disaster evaluations of mitigation effectiveness using remote sensing and other evaluation means could be also used to improve mitigation strategies.

4. Data mining, including data fusion of multimedia data, to discover the best sources of information to use in responding to a particular hazard or current crisis

   Crisis response is complicated by the diversity of data that are needed and used during crises. Some data are resident in Geographical Information Systems (GIS), some data come from numerical simulations, and other data are generated from ad hoc sources such as a bystander's photographs. Thus, technologies are needed to enhance the accessibility of data from multiple sources. During an emergency or mitigation study, these data mining technologies can be employed to uncover data and intelligence that are not available under normal conditions.

5. Information triage to analyze, prioritize, and communicate information from various sources to parties with the need to know

   - This information may be different for different users, but must be coordinated. It may also be different for the same user at different times, so it is valuable to have an adaptive user interface that responds to different levels of user performance under conditions of stress or learning. For example:

   - On-site relief workers need to know who to look for, the location of hazards such as live electricity or potential gas leaks, and what to do next

   - Managers of the relief effort, who are in a mobile control center located nearby, need to direct the efforts of relief workers and relief assets – from rescue, to repair, to medical, to mortuary

   - Personnel at the local, state, regional, and national disaster centers need to conduct virtual conferences with each other and with experts located anywhere around the world to plan the overall response effort and to identify secondary risks such as gas leaks and the locations of potentially hazardous materials releases

6. Privacy and security permissions, especially in mobile technologies, and the ability to change them rapidly as crises progress

   Technologies must be developed that would enable relief workers, for example, to access data normally unavailable about the occupants of buildings during an evacuation or other emergency situation. With the proper privacy and security permissions, emergency relief workers could access smart cards containing medical data normally accessible only by select health care providers in order to treat an unconscious victim.

7. Domain-specific "judgement support" or decision support functionality to assist a person who must perform an unfamiliar function in a crisis situation or during the development of mitigation strategies. One way to do this is to make the knowledge and wisdom of domain experts available and accessible on the scene or over a high speed Internet connection.

8. Prototype, test, and demonstrate the viability and worthiness of tools and software for crises management, preparedness planning, training, or mitigation strategy development.

   Researchers will participate in the experimental deployment of information systems "in the field." These testbeds are a vital element in assuring an active engagement with the operational/user communities.

9. Research on factors inhibiting deployment of information technology in the application domain

   Researchers will identify and study factors that slow the adoption of information technology in the crises management community. Such factors might include legal and regulatory barriers, lack of end-user training, lack of technology transfer mechanisms, the absence of compelling cost-benefit analysis, or a lack of technical standards or other mechanisms for interoperability.

In addition to conducting R&D, researchers will develop educational programs and curricula for students and career professionals in the emergency management field and help transfer new technologies to appropriate organizations. The ETC will also help build communities of researchers, companies, Government officials, users, and other stakeholders by convening conferences and workshops, developing research agendas, and supporting intellectual infrastructure such as electronic print archives, collaboratories, databases, and case studies of successful and unsuccessful uses of information technology.

The ETC's goal will be to develop technology and work with emergency response organizations to transfer technology into operational use, resulting in significant reductions in severity of property damage and loss of life due to natural and man-made disasters.

Proposed Virtual ITCM Enabling Technology Center

Since the Crisis Management community largely lacks affordable and ubiquitous access to cutting-edge technology, most disaster management and crisis response practitioners are eager to work with the technological and scientific communities to help identify research needs and evaluate, exercise, and operationally deploy new technologies. A Federally-sponsored ITCM ETC will provide a forum to foster this collaborative research.

The following chart identifies advantages and disadvantages of different types of ITCM ETCs.

Type of ETC	Advantages	Disadvantages
Geographically-based *(state or regional)*	*Close coordination within a specific region could improve response capabilities for regional high-risk hazards.*	*May exclude or limit crosscutting low-cost enhancements used to respond to lower risk hazards that may benefit non-contiguous regions.*

Hazard-based *(earthquakes, fire, volcanoes, floods, hurricanes, etc.)*	*Could develop exceptional capability to respond to a specific type of disaster.*	*May be too expensive when priced against a single hazard.*
Technology-based *(computing, communication, human-centered, security, etc.)*	*Could drive down cost of a single technology and allow wide application of the technology to mitigate or respond to disasters.*	*Focuses on development of a single technology when combinations of different technologies are needed to effectively respond to or mitigate a disaster.*
Virtual *(exploiting collaboratories, distance learning, Internet/intranet resources within a distributed information infrastructure)*	*Enables broad participation regardless of geographic location by exploiting distance learning and other interactive resources to demonstrate, distribute, and engage all contributors and practitioners. Focuses on integrating the best technologies and applying them to various types of hazards in different geographic locations.*	*Perceived loss of single agency control.*

The ITCM Team proposes a Virtual ITCM ETC that is strongly dependent on the capability of high-density, high-speed digital communications to integrate technologies developed at distributed Affiliated Institutions (examples in APPENDIX A) funded by the ETC.

The Virtual ITCM ETC will benefit from the diverse foci and expertise of the different Affiliated Institutions and provide a forum for close interaction among the funded Affiliated Institutions, universities, local disaster management teams, and Federal agencies.

Proposed ITCM ETC Budget (in millions)

The following chart contains proposed budget numbers for the establishment of a Federal Virtual ITCM ETC.

	Low	**Medium**	**High**
FY 2001-2002	5	10	10
FY 2003-2005	10	10	15

The low scenario would allow the ETC to move into the planning stages. Under the high scenario, the ETC would be able to address key topics in the R&D agenda and hazards in critical geographical areas.

Federal participants would include IT^2 and CIC agencies and other agencies such as the Federal Emergency Management Agency (FEMA) and the United State Geological Survey (USGS). For the IT^2 and CIC agencies, budgeting could be done by each agency and coordinated through the established IT^2 and CIC processes as well as processes established for the ETC. State and local governments, universities, and the private sector could participate through grants, contracts, cooperative agreements, or other arrangements as appropriate.

Appendix A

Examples of Crisis and Emergency Management Research Centers

Federal

Aviation Weather Center (AWC): NOAA; Kansas City, Missouri. Enhances aviation safety by issuing warnings, forecasts, and analyses of hazardous weather to aircraft in flight and to the aviation community. The center also forecasts weather conditions affecting domestic and international aviation interests out to two days. The AWC is one of nine centers within the National Centers for Environmental Prediction (NCEP).

URL: http://www.awc-kc.noaa.gov

Cascades Volcano Observatory (CVO): DOI/USGS; Vancouver, Washington. Provides accurate and timely information pertinent to the assessment, warning, and mitigation of natural hazards (volcanoes, earthquakes, landslides, and debris flows) and performs research into the effects of geologic or hydrologic processes on the landscape (e.g., volcanic gases on the atmosphere, increased sediment transport on streams).

URL: http://vulcan.wr.usgs.gov

Center for Integration of Natural Disaster Information (CINDI): DOI/USGS; Reston, VA. A research facility operated by the USGS to develop better ways to integrate and disseminate disaster data and information.

URL: http://cindi.usgs.gov/events/index/html

Climate Prediction Center (CPC): NOAA; Washington, D.C. Maintains a continuous watch on short-term climate fluctuations to diagnose and predict them. Assists agencies both inside and outside the federal government in coping with climate-related problems such as food supply, energy allocation and water resources. The CPC is one of nine centers within the NCEP.

URL: http://nic.fb4.noaa.gov

Earth Resources Observation Systems (EROS) Data Center (EDC): DOI/USGS; Sioux Falls, SD. Handles data collection and distribution of images from satellites and aircraft. The EDC holds the three decades of land-surface phenomena information within the National Satellite Land Remote Sensing Data Archive. The EDC also acts as the Distributed Active Archive Center (DAAC) for land processes on behalf of NASA's Mission to Planet Earth.

URL: http://edcwww.cr.usgs.gov/eros-home.html

Environmental Modeling Center (EMC): NOAA; Camp Springs, MD. Improves numerical weather, marine, and climate predictions at the NCEP through research in data assimilation and modeling. The EMC develops, improves and monitors data assimilation systems and models of the atmosphere, ocean, and coupled systems using advanced methods developed internally as well as cooperatively with scientists from universities,

NOAA laboratories and other government agencies, and the international scientific community. The EMC is one of nine centers within the NCEP.

URL: http://nic.fb4.noaa.gov:8000

FEMA National Mapping and Analysis Center and Regional Offices: FEMA; Washington, D.C. Maintains baseline disaster management data and develops integrated products distributed to regional offices, which further assimilate local information for emergency management purposes.

URL: http://www.fema.gov/hu98/tracks98.gif

FEMA National Map Service Center: FEMA; Washington, D.C. Maintains Flood Insurance Rate Maps and other material related to flood hazard mitigation and protection. Detailed maps of communities may be ordered from this source at low cost.

URL: http://www.fema.gov/msc

Hawaiian Volcano Observatory (HVO): DOI/USGS; National Park, HI. Monitors and studies Hawaii's hazardous volcanoes to predict and record eruptive activities and to implement public safety measures.

URL: http://hvo.wr.usgs.gov

Hazards Mitigation Center: DOE; Lawrence Livermore National Laboratories. LLNL has been investigating and assessing the hazards associated with natural phenomena for DOE since the 1970s. DOE is concerned about possible damage to its facilities throughout the country due to such extreme natural hazards as earthquakes, severe storms, floods, lightning, volcanic eruptions, and extreme hot or cold.

URL: http://www-ep.es.llnl.gov

Hydrometeorological Prediction Center (HPC): NOAA; Camp Springs, MD. Provides basic hydrometeorological analysis and forecasts for National Weather Service field offices and the entire meteorological community. HPC meteorologists are experts in quantitative precipitation forecasting and numerical model interpretation. Products provided by the HPC include surface analyses, outlooks for heavy rain and snow, and weather forecasts through 5 days. The HPC is one of nine centers within the NCEP.

URL: http://www.ncep.noaa.gov/HPC

National Centers for Environmental Prediction (NCEP): NOAA/NWS; Washington, D.C. Provides worldwide weather forecast guidance products. This agency is the starting point for all weather forecasts. It is the parent center for the Tropical Prediction Center and the National Hurricane Center.

URL: http://www/ncep.noaa.gov

National Earthquake Information Center (NEIC): DOI/USGS; Golden, CO. Determines earthquake locations following occurrence, alerts appropriate entities, archives earthquake information and performs active research to improve earthquake detection.

URL: http://www.neic.cr.usgs.gov

National Geophysical Data Center (NGDC): NOAA/NESDIS; Boulder, CO. Manages environmental data in the fields of marine geology and geophysics, paleoclimatology, solar-terrestrial physics, solid earth geophysics, and glaciology.

URL: http://www.ngdc.noaa.gov

National Hurricane Center (NHC): Tropical Prediction Center (TPC), NOAA/NWS; Miami, FL. NHC and its parent center, TPC, maintain a continuous watch on tropical cyclones over the Atlantic, Caribbean, Gulf of Mexico and the Eastern Pacific (from May 15 through November 30); they prepare and distribute hurricane watches and warnings, as well as marine and military advisories; conduct research to evaluate and improve hurricane forecasting techniques; and are involved in public awareness programs. The TPC is one of nine centers within the NCEP.

URL: http://www.nhc.noaa.gov

National Interagency Fire Center (NIFC): DOI (BLM, FWS, NPS, BIA, OAS), USDA (USFS), DOC (NOAA/NWS); Boise ID. Serves as primary U.S. logistical support center for wildfire suppression; also serves as a focal point for wildfire information and technology.

URL: http://www.nifc.gov

National Response Center (NRC): DOT/USCG; Washington, D.C. Serves as the sole national point of contact for reporting all oil, chemical, radiological, biological and etiological discharges into the environment anywhere in the U.S. and its territories; sends alerts to appropriate entities; and serves as the communications and operations center for the National Response Team (NRT).

URL: http://www.dot.gov/dotinfo/uscg/hq/nrc

National Severe Storms Laboratory (NSSL): DOC/NOAA/NWS; Norman, OK. Enhances national capabilities to provide accurate and timely forecasts and warnings of hazardous weather events (e.g., blizzards, ice storms, flash floods, tornadoes, lightning) through research into weather processes, research in forecasting and warning techniques, and development of operational applications and transfer of technology.

URL: http://www.nssl.noaa.gov/~spc

National Weather Service (NWS): NOAA; Silver Spring, MD. Serves to protect the life and property of U.S. citizens from natural disasters by issuing warnings and forecasts for hurricanes, tornadoes, floods, winter and summer storms, and all manner of severe or extreme weather.

URL: http://www.noaa.gov/nws/nws.html

Pacific Disaster Center (PDC): DoD; Kilhei, Maui, HI. The PDC is a center designed to provide world-class information support to federal, state and local disaster managers in mitigation, preparedness, response and recovery for disasters within the Pacific region.

URL: http://www.pdc.org

U.S. Army Engineer Research and Development Center (USAERDC): USACE; Washington, D.C. USAERDC is responsible for coordinating the various research activities throughout the Corps of Engineers.

URL: http://www.usace.gov

Federal/University Partnerships

Alaska Volcano Observatory (AVO): DOI/USGS, UAF/GI, ADGGS: Fairbanks and Anchorage, Alaska. Monitors and studies Alaska's hazardous volcanoes to predict and record volcanic activity and to implement public safety measures.

URL: http://www.avo.alaska.edu

National Domestic Preparedness Consortium (NDPC): A consortium of universities and research institutions funded by the US Department of Justice. The consortium provides emergency responder training for domestic preparedness and supports research in technologies used in response to terrorist and technological disasters. Membership includes Texas A&M University, Louisiana State University, New Mexico Tech, the Nevada Test Site, and Pine Bluff Arsenal.

Southern California Earthquake Center (SCEC): A community of scientists and specialists who actively coordinate research on earthquake hazards at nine core institutions and communicate earthquake information to the public. SCEC is a National Science Foundation Science and Technology Center and is co-funded by the USGS.

URL: http://www.scec.org

Volcano Systems Center (VSC): University of Washington and USGS; Seattle, WA. Formed to integrate research across disciplines to understand the role of volcanic systems in geological evolution.

URL: http://www.vsc.washington.edu

Universities

Center for Advanced Technologies in Earthquake Loss Reduction (ATEL): ATEL, a nine-institution consortium, will develop and apply advanced and emerging technologies for design, construction and retrofitting of buildings and infrastructure to reduce earthquake losses. It will focus on three major elements: performance assessment of the built environment, rehabilitation of critical facilities and response and recovery using new loss-estimation methods and technologies.

Center for Civilian Biodefense Studies: Johns Hopkins University; Baltimore, MD. Fosters the development of national and international medical and public health policies and structures to protect the civilian population from bioterrorism. The Center's principal focus is upon those bioweapons that have the potential to cause catastrophic, potentially destabilizing epidemics.

URL: http://www.hopkins-biodefense.org

Disaster Research Center (DRC): University of Delaware. Social science research center devoted to the study of disasters. The center conducts field and survey research on group, organizational and community preparation for, response to, recovery from natural and technological disasters and other community-wide crises.

URL: http://www.udel.edu/DRC

Institute for Crisis, Disaster and Risk Management: George Washington University; Washington, D.C. Its objective is to improve the disaster, emergency and crisis management plans, actions and decisions of government, corporate and not for profit organizations by transforming theory into practice.

URL: http://wwwseas.gwu.edu/seas/institutes/icdm

Mid-America Earthquake Center (MAE): University of Illinois-Urbana-Champaign. The MAE will work to reduce potential earthquake losses in the central and eastern U.S., concentrating on problems associated with less frequent seismic events and their consequences for individuals, economic systems, and infrastructure. Projects will focus on identification and evaluation of seismic hazards and development of loss-reduction strategies for the build environment.

URL: http://mae.ce.uiuc.edu

Natural Hazards Center (NHC): University of Colorado; Boulder, CO. The NHC is a national and international clearinghouse for information on natural hazards and human adjustments to hazards and disasters. NHC carries out its mission in four principal areas: information dissemination, an annual workshop, research, and library services. The center's prime goal is to increase communication among hazard/disaster researchers and those individuals, agencies and organizations that are actively working to reduce disaster damage and suffering.

URL: http://www.colorado.edu/hazards

Pacific Earthquake Engineering Research Center (PEER Center): University of California-Berkeley. The PEER Center, a consortium of nine institutions, will conduct research in five basic areas: 1) policy, planning and economics; 2) seismic hazards; 3) performance assessment; 4) systems reliability; and 5) innovative technologies. The center will develop a business and industrial partnership program, conduct urban demonstration projects to test research, and provide education programs.

URL: http://peer.berkeley.edu